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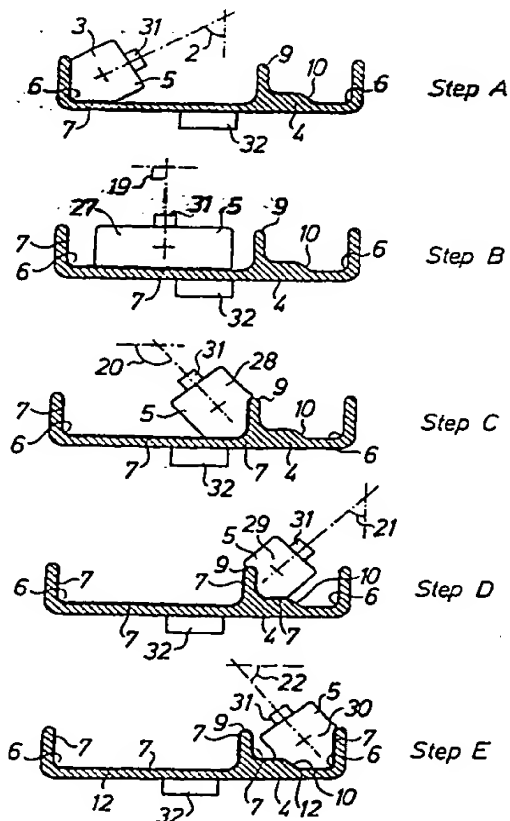
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(54) Title: METHOD FOR TRANSFERRING A PICTURE TO A SURFACE

(57) Abstract

The present invention relates to a method and an arrangement for transferring a conductive picture (12) to an irregular surface of a mobile phone casing (4) for shielding the mobile phone casing from electromagnetic radiation. It also relates to the printing colour used for the conductive picture and tampon pads (5) used for the transferring of the conductive printing colour to the phone casing (4). Conductive partial pictures (7) are printed on the irregular surface of the casing (4) step by step by means of tampon pads until the complete conductive picture (12) is achieved. The tampon pad has a shape corresponding to the surface of the phone casing. The printing colour has a composition, which facilitates the adhering on the tampon pad. The invention also describes a method for printing an electrical circuit pattern on a phone casing (4) by using the above mentioned tampon pads and printing colour.



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10 TITLE OF INVENTION: METHOD FOR TRANSFERRING A PICTURE TO A SURFACE

Field of invention

15 The present invention relates to a method for transferring a conductive picture to an arbitrary surface of a detail by means of a printing means, an arrangement for transferring the conductive picture to the detail, a printing colour used for the conductive picture and printing pads used for the transferring of the printing colour. It also relates to a method for printing an electrical circuit pattern on a detail, e.g. a PCB, by using a printing pad, and an apparatus having at least one electrical component to be shielded from electromagnetic radiation.

Background of the invention

25 It is previously known to transfer a predetermined picture to a surface by means of screen-printing or tampon printing. By means of these methods, it is also possible to print on slightly bulged surfaces. However, today's printing technique imposes strong restrictions when it comes to printing on somewhat more complicated surfaces. Such surfaces can e.g. be very bulged, arched with small radii, angled and provided with angled corners, located adjacent to recesses, bumps, projections, protrusions and holes. There can also be surfaces, which are combinations of the above variations.

30

5 If the skilled person wants to print e.g. a conductive layer using today's technique (spraying, vacuum metallization) on for example the inside of a mobile phone casing which has surfaces of the type described above, this will be very expensive, time consuming and still the result will be unsatisfactory since the printing colour (picture) will not cover the entire irregularities. It should be appreciated
10 that printing of a conductive layer on a detail for shielding purposes, e.g. a mobile phone casing, is thoroughly discussed in the pending applications PCT/SE97/00372 and SE, 9801502-7, respectively, assigned to LM Ericsson, which applications are incorporated herein by reference. However, these applications are not explicitly related to the printing on irregularities of a detail, e.g. a
15 mobile phone casing.

 An object of the present invention is to eliminate this drawback and provide a method and an arrangement, which make it possible to print a determined conductive picture on the more complicated surfaces mentioned above.

 Another object of the present invention is to form preferable printing pads
20 which carry said conductive printing colour to the detail to be shielded.

~~Yet another object of the present invention is to create a conductive printing colour with appropriate tixotropy for applying on the detail to be shielded~~

 Yet another object of the invention is to overcome the drawbacks with the applying of an electrical circuit pattern on a printing circuit board (PCB) by conventional techniques, e.g. screen printing.
25

Summary of the disclosure

 The above objects are achieved by means of a method, an arrangement, a printing pad, a printing colour and another method as claimed in claims 1, 20, 33,
30 37 and 39, respectively.

5 The method and the arrangement according to claims 1 and 20, respectively, describes the printing of a conductive picture on the surface of a detail by means of a printing means using a printing method known per se, wherein conductive partial pictures are printed on the surface of the detail so that every part of the conductive picture is built up step by step until the complete picture is achieved, wherein the
10 conductive picture shields the detail from electromagnetic radiation.

By printing partial pictures on the surface of the detail rather than printing the complete picture in one printing, it is easier to cover all irregularities on the surface of the detail.

Another advantage is that the printing means can have a specific design for
15 each particular irregularity to be printed with a partial picture. This increases of course the surface accessibility of the detail.

The printing pad in claim 33 prints a conductive picture containing a conductive colour on an irregular surface of a detail by means of a printing method known per se, wherein the pad fetches the conductive colour from a kliche' and
20 prints the colour on the detail, which colour shields the detail from electromagnetic radiation, and that the printing pad has a shape corresponding to the surface of the detail to be printed.

Since the pad has a shape corresponding to the detail to be printed, e.g. a mobile phone casing, it is easier for the colour to cover all irregularities of the detail. Moreover, the printing of the detail can be carried out in fewer steps.
25

The metal colour in claim 37 is included in the conductive picture, which is to be printed on the surface of a detail by means of a printing means using a printing method known per se, which colour includes metal particles, an adhesive, a solvent, and an emulsifying agent in order to have an appropriate tixotropy and
30 viscosity for adhering to a printing pad, preferably a silicon tampon pad.

5 In spite of the heavy weight of the metal colour, it adheres very well to a printing pad, preferably a silicon tampon pad, because of its inventive composition.

 The method in claim 39 discloses the printing of an electrical circuit pattern containing metal colour on the surface of detail by means of a printing means using
10 a printing method known per se, wherein the printing means fetches the electrical circuit pattern from a cliché and then print it on the detail.

 The conventional techniques for applying circuit patterns on for example printing circuit boards (PCB) are very time consuming and expensive, e.g screen printing.

15 The method in claim 39 is a very simple and fast way of applying a circuit pattern on for example a PCB; fetching a circuit pattern from a cliché by means of a tampon pad and then printing the pattern on the PCB or a telephone casing. This method could readily be used in a very fast production line described below for manufacturing of phone casings or PCBs applied with this electrical circuit pattern. Wider electrical lines, as for example power lines or antenna pattern lines, are
20 ~~particularly suitable for this method. The method could for example be used for~~
printing the antenna pattern on the flip of the phone casing.

 A short description of the independent claims and their advantages has now been carried out. Below, a brief discussion of advantageous embodiments of the
25 dependent claims will now be discussed.

 A preferable embodiment of the invention is discussed in claim 3, wherein the printing means prints the conductive partial pictures on the surface of the detail from different application angles for better surface accessibility of the irregularities.

5 Since the printing means is applied from different angles, the irregularities of the detail will be better covered by the printing colour.

Another preferable embodiment is disclosed in claim 11, in which a production line method works in the following steps:

- 10 - moving the detail to a first printing station to print by means of the printing pad a first partial picture on a specific area of the detail from a predetermined angle in relation to this area ;
- moving the detail to a second printing station to print by means of another printing pad a second partial picture on another specific area of the detail from another angle in relation to this another specific area;
- 15 - moving the detail to different printing stations in accordance with previous steps building up partial picture by partial picture until the complete picture is finished.

This embodiment describes a profitable production line method for fast manufacturing of printed details, preferably phone casings.

- 20 ~~An interesting~~ embodiment is disclosed in claim 13 in which a rotating drive wheel carrying printing pads prints a conductive picture on details transported on a conveyor line, wherein the printing takes place under motion of both the detail on the conveyor band and the drive wheel. It should be realised that the detail and the printing pad in the above embodiments can be replaced by the mobile phone casing and the tampon pad, respectively.
- 25

Arrangement claims corresponding to the above embodiments could also be found in the appended set of claims.

Preferable shapes of the tampon pad corresponding to irregular surfaces of a phone casing are discussed in the dependent claims. The tampon pad could for ex-

- 5 ample have an oval, axe, flat or pointed shape or even be cut in sections to be more pliable in the casing.

A preferable design of the cliché is suggested in the dependent claims, wherein the cliché at some areas of the surface have deep recesses to contain more colour. These areas correspond to irregular areas of the mobile phone casing
- 10 needing more colour. Also a curved cliché is suggested in the dependent claims for facilitating for the tampon pad to absorb the colour.

An advantageous metal colour, which adheres readily on the tampon pad and on the casing is disclosed in claim 38, in which the metal particles are silver particles, copper particles or silver plaited copper particles.

- 15 Other characteristics of the invention are set out in other dependent claims.

Brief description of the drawings

The present invention will now be described in more detail with reference to preferred embodiments of the present invention, given only by way of examples, and illustrated in the accompanying drawings in which:

- 20 ~~Fig. 1 illustrates the process according to the invention of printing a picture on a complicated surface of a detail;~~

~~Fig. 2 illustrates how a picture is obtained from a printing plate;~~

Fig. 3 illustrates how the picture in figure 2 is transferred to a detail;

- Fig. 4 discloses a diagrammatic view of a printing pad and a detail to be
25 printed, e.g. a mobile phone casing, attached to a holding device;

Fig. 5-6 disclose different printing pads interacting with printing plates for absorbing the printing colour;

Fig. 7 shows a cross-section of the printing pad in Fig. 5-6 in printing mode of a mobile phone casing;

5 Fig. 8 is a printing plate (template) in a sectional view according to the invention;

 Fig. 9 is another printing pad in perspective view with a form corresponding to the printing plate in Fig. 8;

10 Fig. 10 discloses a cross-section view of the printing pad in Fig. 9 being pressed against the interior of a mobile phone casing for printing a conductive colour thereon;

 Fig. 11 is a cross-sectional side view of a mobile phone casing and a preferable tampon pad;

15 Fig. 12 is a preferable production line arrangement of the invention according to Fig. 1;

 Fig. 13 is another production line arrangement of the invention;

 Fig. 14 discloses a cross sectional side view of a printing plate (cliché) according to the invention;

 Fig. 15 discloses a mobile phone with an open flip;

20 Fig. 16 is an exploded view of a front casing, back casing and a component to be shielded in a mobile telephone.

Detailed description of embodiments of the invention

25 In the following description the printing method and the arrangement of the invention will first be described with reference to fig. 1-4 and 11-13, respectively. The printing method (i.e. tampon or screen-printing) itself is of course already known in the prior art and the description will not focus on this. After the description of the method and the arrangement to transfer a picture to an irregular surface, certain preferable printing pads (tampon pads) transferring the conductive picture

5 colour to the detail to be shielded will be discussed together with some preferable advantageous printing colours i.e. conductive colours.

As is obvious from the embodiment illustrated in Fig. 1, the invention comprises a printing method which transfers at least two partial pictures 7 from a template 19 (cliché), and then print these partial pictures to produce a complete picture
10 12 on an irregular surface of a detail 4, preferably with corners 6, projections 9, stepped formations 10 or other irregularities, by means of at least one printing pad 5, which is pressed in different steps A-E against the detail from different applications angles 2, 19, 20, 21, 22 and from different positions 3, 27, 28, 29, 30 as can be seen in Fig. 1. In this manner, the surface accessibility in e.g. a corner 6, a projection etc is increased. In this preferred embodiment, either the detail 4 (e.g. a mobile
15 phone casing), the printing pad 5 or both can be turned in three dimensions to provide the different application positions 3, 27, 28, 29, 30 indicated by the steps A-E, which steps also illustrate that the printing pad has different application angles 2, 19, 20, 21, 22 for each step A-E so that a complete picture 12 containing each partial picture is produced on the complicated surface of the detail 4. In the steps A-E
20 of Fig. 1, it is also realised that the printing pad can have different shapes depending on the form or the structure of the surface of the detail 4 in order to get a more satisfactory printing result.

In Figs. 2 and 3, another embodiment of the invention is illustrated, which
25 is so designed that the printing pad transfers the complete picture 12 or a large partial picture 7 in one or few prints to a complicated surface of the detail. The picture is received from a cliché, template or a printing plate 19 that rests on a normally flat surface by means of the printing pad 5. It should of course be realised that the template could have other different forms, i.e. curved, arched, bulged
30 forms, in order to facilitate the transfer of the printing colour to the entire surface of the printing pad. To be able to get this large partial picture 7 from the template

5 19 for placing it on a larger surface 13, this can be carried out by letting the printing pad 5 carry out a rolling, rocking or tilting motion 11 back and forth on the template so that the printing pad 5 moves from a position 14 to another position 15 as can be seen in fig.2. If the template 19 is more or less curved/bulged when the partial picture 7 is transferred from the template, the rolling movement 11 does not
10 have to be so large, as compared to when the template 19 is flat, since the printing pad 5 receives printing colour on a larger surface area 13 by contacting the curved sides of the template at an earlier stage of the movement 11. For example the template disclosed in Fig. 5-6 could be used for this rolling movement of the printing pad for absorbing the printing colour.

15 The picture 7 fetched from the cliché is then transferred to the detail 4 by pressing the printing pad under a rolling/tilting movement back and forth against the detail 4. When at least one large partial picture 7 or a complete picture 12 is to be printed, this is achieved by pressing the printing pad against the detail 4 and at the same time let the template roll 18 over the detail to be printed. This rolling
20 motion 18 of the printing pad is illustrated in Fig.3. With this movement of the pad 5 a larger surface of the detail is printed compared to the case without the movement 18. Moreover, a complicated partial picture 7 can be printed at the same time on for example the perpendicular sides 16, 17 and in the corner 6 of the detail 4. The movement 11 in Fig.2 can be provided by letting the template 19 and/or the
25 printing pad 5 move at the same time. The movement 18 in Fig.3 can also be obtained by letting the printing pad 5 or the detail 4 or both move at the same time.

The printing method described above can be carried out by screen-printing, tampon printing or other known printing methods. However, the invention will focus on tampon printing since it empirically has shown to be very effective for
30 printing on irregular surfaces. It should be appreciated that the picture absorbed from the template 19 is a thin layer, which could be made of an inorganic material

5 e.g. a metallic conductive material. The picture could also be made of an organic material e.g. a plastic material or combinations of said materials. The purpose of the colour is to shield the detail 4 from electromagnetic radiation. Below, the composition of a preferred printing colour/picture will be discussed in more detail.

10 With reference to Fig. 1-4, a method is provided in which the detail 4 to be printed is placed in a holding device 32 which is movable so that the position of the detail can be changed, whereby the detail 4 can be subjected to different application angles 2,19,20,21,22 and positions 3,27,28,29,30 by the printing pad/tampon pad. Thus, in accordance with the invention the position of the detail can be fixed at the moment of printing so that an easily accessible partial surface
15 of the detail is formed whereby a screen or a tampon printing pad easily can print at least one partial picture thereon.

On the market today, one works with fixed details to be printed. The skilled man is expected to complete the printing with one single print. If the detail has a complicated surface structure, it will not be possible to completely transfer the
20 picture to the detail. If someone in this situation would like to print several times on the detail to complete the printing, the detail has to be released and then fixed ~~again in a new position in order to obtain a new application angle for a printing pad or a screen frame to complete the picture.~~

25 Thus, in accordance with the present invention it is possible to carry out partial prints from different directions 2,19,20,21,22 so that every part of the picture is built up step by step until the complete picture is finished.

To further improve the possibilities of printing on complicated surfaces, several printing machines 31, each equipped with at least one partial picture, can work against the detail 4. These will print the partial picture, one at a time, on the
30 detail in e.g. a production line, wherein the whole picture then will be finished quicker. This could be the case in Fig. 1, in which a fixed printing machine 31 in

5 step A prints a partial picture 7 in the corner 6 of the mobile phone casing 4. In Fig. 1 the casing and the pad are seen in a cross-sectional view. The phone casing fixed in a holding device 32 is then moved to another fixed printing machine in step B, in which another printing pad with a specific shape corresponding to the surface to be printed, prints a new partial picture 7 on the surface of the phone casing, wherein the phone casing then is moved to the next fixed printing machine in step C and so forth. This method with a production line of fixed printing stations for printing the conductive metal layer on the casing 4 while it is transferred to the different stations is considered to be the best way of carrying out the invention. This method and other preferable methods will now be described in more detail
15 below with reference to the drawings.

In another embodiment the mobility of the attached phone casing can be increased, and thereby create even better accessibility for printing on complicated surfaces in that it is fixed movably in a robot 32 which can move in three dimensions x,y,z (Fig. 4). This robot 32 can then interact with at least one printing machine, which for example could be controlled by another robot 31. Also, mobility
20 can be obtained by letting the holding device/robot 32 be movably connected along a production line, which moves the mobile phone casing to the printing machines in steps A-E in Fig. 1.

It is also possible to envisage that the printing pad and/or the screen frame
25 is movably attached in a corresponding manner as the phone casing is attached to the holding device/robot, preferably to at least one robot which can fetch different printing pads with different partial pictures and then apply them to the phone casing. Of course, one can envisage that both the phone casing and the printing pad or the screen frame are movably attached to the holding devices/robots 31,32 at the
30 same time.

5 For further improvement of the ability to print on complicated surfaces, the mobility of the holding device/robot and/or the printing pad can be used not only for each partial printing but also during the moment of printing itself. Then, it will be possible to turn the printing surface in three dimensions x,y,z in compliance with the form of the phone casing during the moment of printing so that irregular
10 surfaces on the phone casing will be better accessible. Then, each partial print can print a larger surface and thereby even manage to print the predetermined surface with perhaps only one single print.

The preferable embodiment briefly discussed above is obtained by means of said production line equipped with a number of pre-set printing machines 31 (steps
15 A-E), which each can print from a predetermined angle 2,19,20,21,22 and a predetermined position 3,27,28,29,30. The holding device/robot 32 with the mobile phone casing 4 to be printed is then moved between different printing stations in steps A-E and stops at each printing machine 31 (for example step A) where a partial printing is carried out from the application angle 2, wherein the holding device/robot 32 with the mobile phone casing 4 then is moved to the next printing
20 machine (step B) which prints from another angle 19 and from another position 27 ~~on the next partial surface of the casing 4 and then moved on to the remaining~~ printing stations (steps C-D) until all prints of the predetermined picture are completed. A production-line arrangement according to Fig. 1 can be seen in Fig. 12,
25 in which the phone casings to be printed are transferred on a conveying line 37 to different printing stations I, II, III. In Step I corresponding to step B in Fig. 1, the mobile phone casings 4 are printed straight from above by the printing device 31,5. Approximately 95 % of the surface of the casing are printed in this step. Depending on the desired thickness of the coating (picture) on the casing, the printing device can print an arbitrary number of times on the same surface. If for example the
30 thickness of the coating fetched from the cliché is 2 μm and the desired thickness for good conductivity on the casing is 6 μm , the printing device has to fetch the

5 colour three times from the cliché and print it on the casing three times. In steps II and III the printing devices 5,31 print on the casing 4 from the side with different application angles corresponding to steps A,C,D and E in Fig. 1. Another preferable production-line arrangement can be seen in Fig. 13 wherein a drive wheel 31 carrying four tampon pads 4 prints the shielding picture (coating) on the casing 4
10 under simultaneous movement of conveyor line 37, drive wheel 5,31 and the cliché 19. While the lowest tampon pad A prints the coating on the casing 4 the upper one fetches the colour from the rotating cliché. The cliché is round in its shape and during rotation it receives colour from a colour container. This arrangement is of course very effective when printing the flat surface of the casing, and the printing
15 speed could be extremely high. However, by turning or tilting the casings while they are in contact with tampon pad A, it should also be possible to print in corners, recesses etc .

In the methods described above, the picture to be printed on the detail is fetched from a printing plate, cliché (template) surface 19 that can be flat or
20 formed as a bulging surface. This fetching technique is known per se in the prior art. In Fig. 14 an inventive cliché is seen from a cross-sectional side view. The ~~pattern on the cliché 19 is achieved by means of photo etching, and some parts of~~
~~this pattern have deep recesses 36 to be able to contain more colour.~~ The positions of these deep recesses 36 in the cliché depend on the appearance of the casing surface to be printed. Thus, a deep recess 36 should correspond to a strong irregularity
25 of the casing surface so that the tampon pad 5 easily could fetch and print this larger amount of colour on this irregularity in order to cover it better. It should be realised that in the description the more general term printing plate relates to a cliché 19 or a template 19. The printing pad, the screen frame and the printing
30 plate can be bulged and have differently shaped surfaces in order to better enable printing on a casing 4 with complicated surfaces, which will be described below with reference to Fig. 5-10. During the actual moment of printing when the prede-

5 terminated picture is to be transferred to the casing 4, this can take place under
movement of either the casing 4 and/or the printing pad/screen frame as described
above. To further improve the accessibility for the printing pad/screen frame, also
a movement of the printing pad/casing to be printed takes place so that the appli-
cation angle is also changed during the actual moment of printing. The rolling
10 movement 11,18 of the printing pad in Fig. 2, 3 could be performed by means of a
robot 32.

An important component in the present invention is of course the printing
colour containing metal or other conductive elements, which colour is to be printed
on the casing 4 for shielding purposes. It should be realised that the term colour in
15 this invention is equivalent with the term coating. However, the term colour is
more appropriate since the invention relates to a printing method.

A preferable metal colour includes metal particles (especially silver parti-
cles), an adhesive, a solvent and an emulsifying agent in order to obtain a colour
with appropriate tixotropy and viscosity, and which is conductive and adheres to
20 the printing pad. However, colour containing silver particles is very expensive (ap-
prox. 200 \$/kg). To achieve cheaper colour, copper or silver plated copper parti-
cles are used in the colour as the conductive material. The colour is quite heavy
and the weight is about four times higher than ordinary decoration colour. In spite
of the weight, the metal colour with the composition described above adheres very
25 well to a tampon pad, particularly to a silicon tampon pad. With the inventive tam-
pon printing method it is easy to apply a metal colour layer with a predetermined
thickness all over the casing 4 to increase the conductivity and thereby the shield-
ing effect. An arbitrary predetermined thickness of the metal layer on the casing
can be achieved by letting the tampon pad fetch a metal layer with a specific thick-
30 ness an arbitrary predetermined number of times from the template and then print
it on the casing the same number of times. Normally the thickness of the layer

5 should be larger than 3 μm , preferably 15-50 μm , to have good conductive properties. As mentioned above the tampon printing method, in contrary to the spraying and vacuum vaporisation method, applies the metal layer on the casing with an overall equal and even thickness; this property lies inherent in general printing technique, which makes it most convenient for using in shielding of electrical
- 10 components. The thickness of the entire layer applied to the casing 4 is the same as the thickness of the layer received from the template 19. The layer applied with the spraying or the vaporisation technique is uneven and certain areas have thickenings implying an additional cost since the colour is very expensive.

The following description will now be directed to Fig. 5-11 describing different shapes of the printing plates and the tampon pads, respectively. Instead of
15 the oval shaped and rectangular shaped tampon pads disclosed in Fig. 1 the tampon pad 5 could be axe shaped as can be seen in Fig. 5 and 6. With this axe form of the tampon pad it is possible to print the entire metal layer with one print as can be seen in Fig. 7. When the tampon pad in Fig. 7 is pressed against the casing 4 even
20 the sides of the casing is covered and printed by the pad. In Fig. 6 the axe shaped tampon pad is pressed against the curved template 19 for absorbing the colour. Since the template is curved with a form corresponding to that of the tampon pad the colour will adhere to the tampon pad easier and faster. As can be seen in Fig. 6 even the sides 34 of the tampon pad can receive the colour. Fig. 8 and 9 disclose
25 other forms of the template and the tampon pad, respectively. The form of the template in Fig. 8 corresponds to the form of the tampon pad in Fig. 9, wherein the tampon pad easily can absorb the colour from the template. In Fig. 10 the tampon pad 5 in Fig. 9 is pressed against a mobile phone casing 4, the side-edges of which are covered and printed in a very efficient manner. Other forms of the tampon pads
30 are of course possible. The pad could for example have one or many projections at the bottom 33 in order to better cover irregularities of the casing 4. The pad 5 could have cavities at the bottom 33 or elsewhere in order to be more soft and pli-

5 able. The pad (soft) could for example be injected with air at the printing moment
(Fig. 7,10), wherein the pad would increase in size and even penetrate the smallest
recesses in the casing 4 etc. In Fig. 11 another preferable shape of a tampon pad 5
is disclosed, which pad is cut in different sections in order to be more pliable in
relation to the casing 4 for printing more effectively on the sides and on the ir-
10 regularities of the casing. The different forms of the pads and the printing plates in
the figures could of course readily be implemented in the production line accord-
ing to Fig. 1, 2, 12 and 13.

15 In order to implement the invention, combinations and variations of the
methods described above can of course be achieved to improve the accessibility
upon printing.

It should be realised that the above method and arrangement also could be
used for printing an electrical circuit pattern on the detail (4). In this case we are
only interested in the conductivity of the circuit pattern and not the shielding ef-
fect. The electrical circuit pattern is etched on the cliché, fetched by the printing
20 pad (tampon pad) and then printed on the detail e.g. a PCB, a mobile phone casing
~~4. It should also be realised that with this method a first conductive circuit pattern~~
~~could be printed on the detail. Then another insulating colour (layer) could be~~
~~printed above this first conductive pattern not covering the complete conductive~~
pattern. After that a second conductive pattern could be printed on the insulating
25 colour, which second conductive pattern contacts the first conductive pattern at
those places not covered by the insulating colour. In this way several different lay-
ers (insulating and conductive) could be built up forming a complex circuit struc-
ture. The discussed method is particularly advantageous for printing power lines
and antenna pattern on the casing or the flip of the mobile phone casing since the
30 power lines or antenna pattern lines are wider than ordinary circuit lines. In Fig. 15

- 5 a mobile phone 38 with a flip 39 is disclosed. The antenna pattern 40 on the flip is printed by means of the above discussed tampon pad.

In Fig. 16 an exploded view of a front casing 41 of a mobile phone, a back casing 42 of a mobile phone and an electrical component 44 is disclosed. The interior of the front and back casings 41,42 are applied with the above discussed conductive printing colour by means of the above discussed methods in order to shield the environment from electromagnetic radiation created by the component 44, which component 44 is mounted inside the mobile telephone. The panel 43 arranged between the two electrical components 44,45 inside the telephone could also be coated with the conductive printing colour in order to shield the component 45, e.g. the radio transceiver from the other component 44, e.g. a clock circuit.

It would be appreciated by those of ordinary skill in the art that the present invention can be embodied in other specific forms without departing from the spirit or essential character thereof. The presently disclosed embodiments are therefore considered in all respects to be illustrative and not restrictive. The scope of the invention is indicated by the appended claims rather than the foregoing description, and all changes which come within the meaning and range of equivalence thereof are intended to be embraced therein.

5

Claims

1. A method for printing a conductive picture (12) on the surface (6,9,10) of a detail (4) by means of a printing means (5,31) using a printing method known per se, **characterised in** that conductive partial pictures (7) are printed on the surface of the detail (4) so that every part of the conductive picture (12) is built up step by
10 step until the complete picture (12) is achieved, wherein the conductive picture (12) shields the detail from electromagnetic radiation.

2. A method as claimed in claim 1, **characterised in** that the surface of the detail (4) has irregularities, e.g. corners, recesses, projections, (6,9,10).

3. A method as claimed in claims 2, **characterised in** that the printing
15 means prints the conductive partial pictures on the surface of the detail from different application angles (2,19,20,21,22) for better surface accessibility of the irregularities.

4. A method as claimed in any of claims 2 or 3, **characterised in** that the printing means prints the conductive partial pictures on the surface of the detail
20 from different positions (3,27,28,29,30) for better surface accessibility of the irregularities.

5. A method as claimed in any of claims 2-4, **characterised in** that the printing means comprises a printing pad (5).

6. A method as claimed in any of claims 2- 6, **characterised in** that the
25 printing pad (5) has a shape corresponding to that specific irregular area (6,9,10) of the surface of the detail to be printed.

7. A method as claimed in claims 5 or 6, **characterised by** a movement of the printing pad (5) and/or the detail (4) during the printing moment itself so that irregular surfaces of the detail are better accessible.

5 8. A method as claimed in any of claims 5-7, **characterised in** that the printing pad fetches the partial picture (7) from a printing plate (19) before printing it (7) on the detail.

 9. A method as claimed in claim 8, **characterised in** that the printing pad fetches a larger partial picture from the printing plate by carrying out a rolling motion (11) on the printing plate in order absorb the partial picture on the sides (13) as well as on the flat surface (33) of the pad (5).

 10. A method as claimed in claims 8 or 9, **characterised in** that the printing pad prints the picture on the detail by carrying out a rolling motion (18) on the detail during the printing moment, wherein a larger surface area (6,16,17) of the detail (5) is printed.

 11. A method as claimed in any of claims 5- 10, **characterised by** the steps of:

- moving the detail (5) to a first printing station (31, step A) to print by means of the printing pad a first partial picture (7) on a specific area of the detail from a **predetermined angle (2) in relation to this area ;**
- moving the detail to a second printing station (31, step B,C,D,E) to print by ~~means of another printing pad a second partial picture (7) on another specific~~ area of the detail from another angle (19,20,21,22) in relation to this another specific area;
- moving the detail to different printing stations (31) in accordance with previous steps building up partial picture (7) by partial picture (7) until the complete picture (12) is finished.

 12. A method as claimed in claim 11, **characterised in** that the printing stations (31) are provided along a production line (37), preferable a conveyor band.

5 13. A method as claimed in any of claims 5-10, **characterised by** using a rotating drive wheel (31) carrying printing pads (5) for printing on details (4) transported on a conveyor line (37), wherein the printing takes place under motion of both the detail on the conveyor band and the drive wheel.

10 14. A method as claimed in claim 13, **characterised in** that when the printing pad (5,A) is in printing contact with an arbitrary detail, another printing pad (5,B) interacts with a counter rotating printing plate wheel (19) fetching the partial picture (7,12) to be printed on another detail (4).

 15. A method as claimed in any of the preceding claims, **characterised in** that the detail is a mobile phone casing (4).

15 16. A method as claimed in any of the preceding claims, **characterised in** that the picture is a metal printing colour (7,12) or a metal printing coating (7,12).

 17. A method as claimed in claim 16, **characterised in** that an arbitrary pre-determined thickness of the metal printing coating (7,12) on the detail is achieved by letting the printing pad fetch a metal printing coating with a specific thickness
20 an arbitrary number of times from the printing plate and then print it on the detail **the same number of times.**

 18. A method as claimed in 5-17, **characterised in** that the printing pad is a tampon pad (5).

25 19. A method as claimed in any of claims 8-17, **characterised in** that the printing plate is a cliché (19) or template (19).

 20. An arrangement for printing a conductive picture (12) on the surface (6,9,10) of a detail (4) by means of a printing means (5,31) using a printing method known per se, **characterised in** that the printing means prints conductive partial pictures (7) on the surface of the detail (4) step by step to build up the complete

5 conductive picture (12), wherein the conductive picture (12) shields the detail from electromagnetic radiation.

21. An arrangement as claimed in claim 20, characterised in that the surface of the detail (4) has irregularities.

22. An arrangement as claimed in claim 2, characterised in that the printing means comprises at least one printing machines (5,31), equipped with at least one partial picture (7), which printing machine works against the detail (4) along a production line (37).

23. An arrangement as claimed as in claim 22, characterised in that the printing machine (31) carries a printing pad (5) with a shape corresponding to the surface of the detail to be printed, and the detail is attached to a holding device (32), wherein the printing machine and /or the holding device are movable in relation to each other in the printing moment itself.

24. An arrangement as claimed in claim 22, characterised in that different printing machines (I,II,III,31) print partial pictures from different angles (2,19,20,21,22) on the detail while passing the printing machines on a conveyor band (37).

25. An arrangement as claimed in claim 22, characterised in that the printing machine is a rotating drive wheel (31) carrying several printing pads for printing on details transported on a conveyor line (37).

26. An arrangement as claimed in claim 25, characterised in that one printing pad (B) on the rotating drive wheel interacts with a counter rotating printing plate for fetching the picture while another printing pad (A) prints on the passing detail (4).

27. An arrangement as claimed in any of claims 23-26, characterised in that the printing pad is a tampon pad (5,A,B), the detail is a mobile phone casing

- 5 (4), printing plate is a template/cliché and the picture contains a conductive colour (7,12).

28. An arrangement as claimed in claim 27, **characterised in** that the cliché has a shape corresponding to the shape of the tampon pad.

- 10 29. An arrangement as claimed in claim 27 or 28, **characterised in** that the tampon pad has a shape corresponding to the surface of the mobile phone casing to be printed.

30. An arrangement as claimed in claims 27 or 29, **characterised in** that the cliché is curved.

- 15 31. An arrangement as claimed in 27-30, **characterised in** that the pattern on the cliché is achieved by means of an etching technique.

32. An arrangement as claimed in 27-31, **characterised in** that certain parts of the cliché pattern have deep recesses in order to contain more colour (7,12), which recesses correspond to those areas (6,9,10) of the phone casing with strong irregularities.

- 20 33. A printing pad (5) for printing a conductive picture (7,12) containing a conductive colour on an irregular surface (6,9,11) of a detail (4) by means of a ~~printing method known per se, characterised in that it is arranged to fetch the~~ conductive colour from a cliché (19) and print the colour on the detail, wherein the colour shields the detail from electromagnetic radiation, and that it has a shape
25 corresponding to the surface of the detail to be printed.

34. A printing pad as claimed in claim 34, **characterised in** that it is a tampon pad and that the detail is a mobile phone casing, wherein the tampon pad has a shape corresponding to the irregular surface of the mobile phone casing to be printed.

5 35. A printing pad as claimed in claim 34, characterised in that it has an axe, oval, round, flat or pointed shape.

 36. A printing pad as claimed in claims 34 or 35, characterised in that the tampon pad is cut into different sections in order to be more pliable on the mobile phone casing (4).

10 37. A metal colour included in a conductive picture (12) to be printed on the surface (6,9,10) of a detail (4) by means of a printing means (5,31) using a printing method known per se, characterised in that it includes metal particles, an adhesive, a solvent, and an emulsifying agent in order to obtain a colour with appropriate tixotropy and viscosity for adhering to a printing pad, preferably a silicon tampon pad.

 38. A metal colour as claimed in claim 37, characterised in that the metal particles are silver particles, copper particles or silver plated copper particles.

 39. A method for printing an electrical circuit pattern containing metal colour on the surface of detail (4) by means of a printing means (5,31) using a printing method known per se, characterised in that the printing means fetches the
20 ~~electrical circuit pattern from a cliché and then print it on the detail.~~

 40. A method as claimed in claim 39, characterised in that the detail is a PCB (4).

25 41. A method as claimed in claim 40, characterised in that the electrical circuit pattern is power lines or antenna lines.

 42. A method as claimed in claims 39 or 41, characterised in that the detail is a mobile telephone casing and the printing means is a tampon pad (5), wherein the electrical circuit pattern is printed on the casing (4) or on the flip of the casing.

30 43. A method as claimed in any of claims 39 to 42, characterised in that the printing means prints an insulating pattern above the electrical circuit pattern

5 not covering the complete electrical circuit pattern, and then prints another electrical circuit pattern above the insulating pattern, wherein the both electrical circuit patterns contact each other at those places not covered by the insulating colour, wherein a complex structure is built up containing an arbitrary number of electrical circuit pattern layers and insulating layers, respectively.

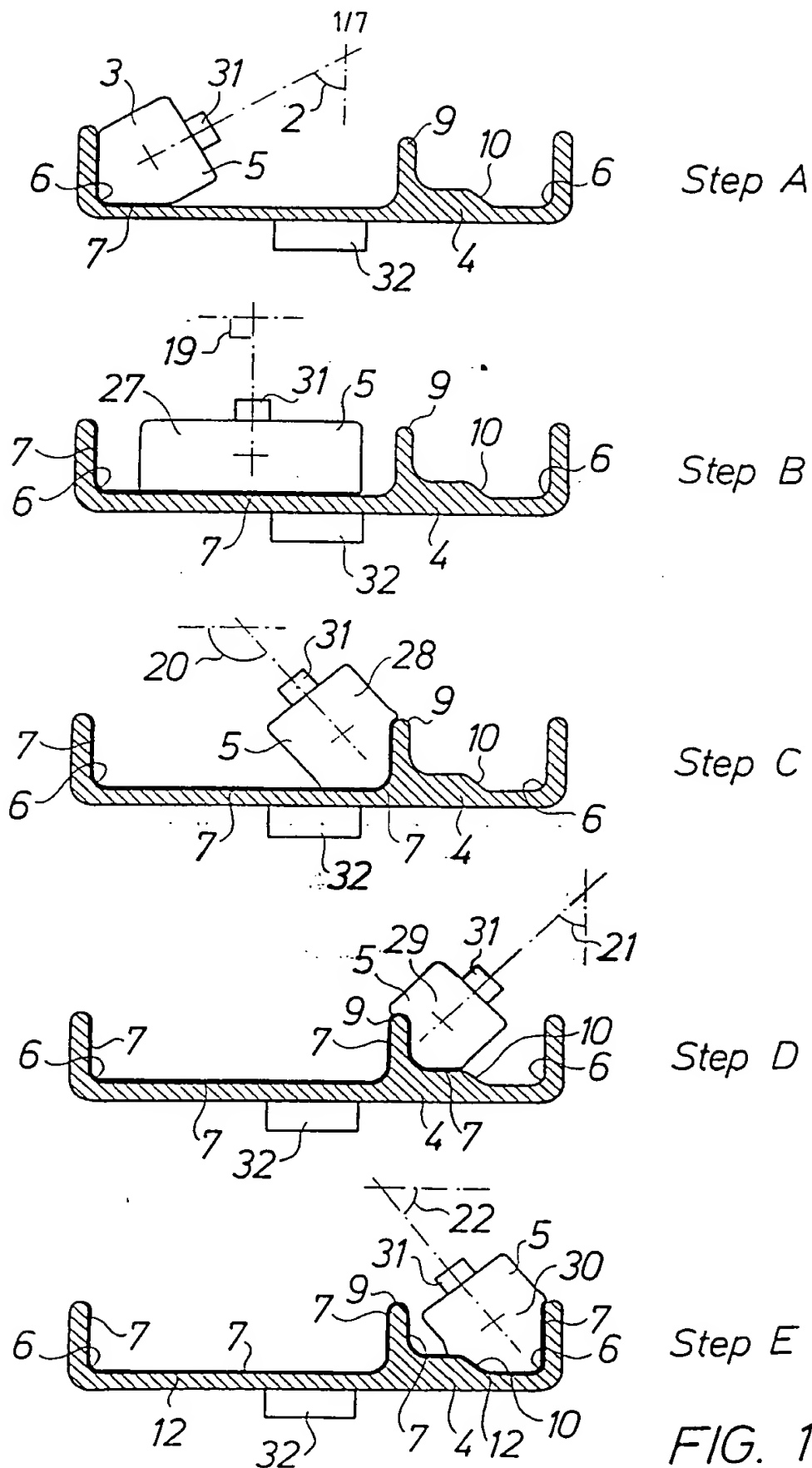
10 44. An apparatus (38) having at least one electrical component (44;45) to be shielded from electromagnetic radiation as claimed in any of claims 1 to 19.

45. An apparatus as claimed in claim 44, **characterised in** that the apparatus is a mobile phone (38).

15 46. An apparatus as claimed in claim 44, **characterised in** that it is a computer device.

47. An apparatus as claimed in claims 44 or 46, **characterised in** that a panel (43) arranged in the apparatus (38,41,42) between two components (44,45) and applied with conductive printing colour, shields the first component (45), e.g. radio transceiver from the other component (44), e.g. a clock circuit.

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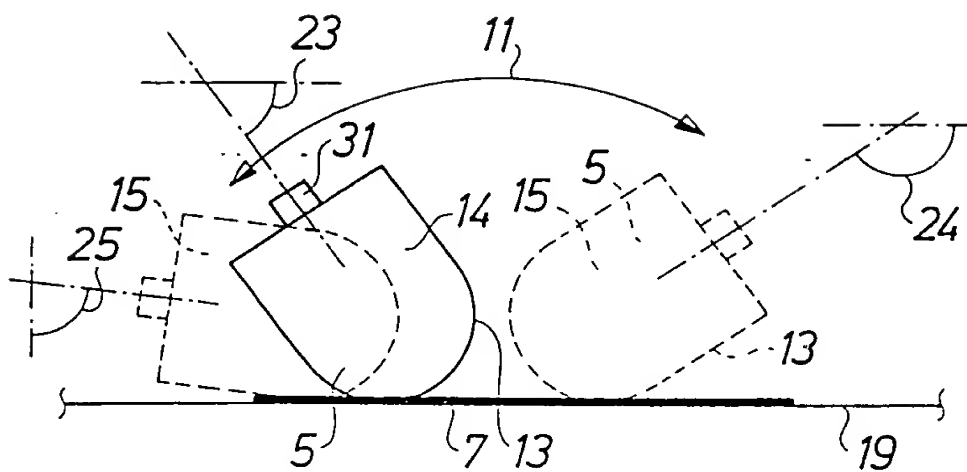


FIG. 2

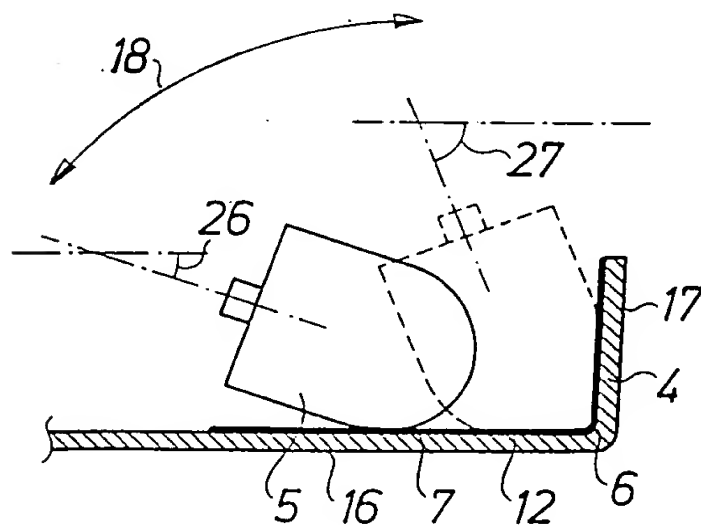
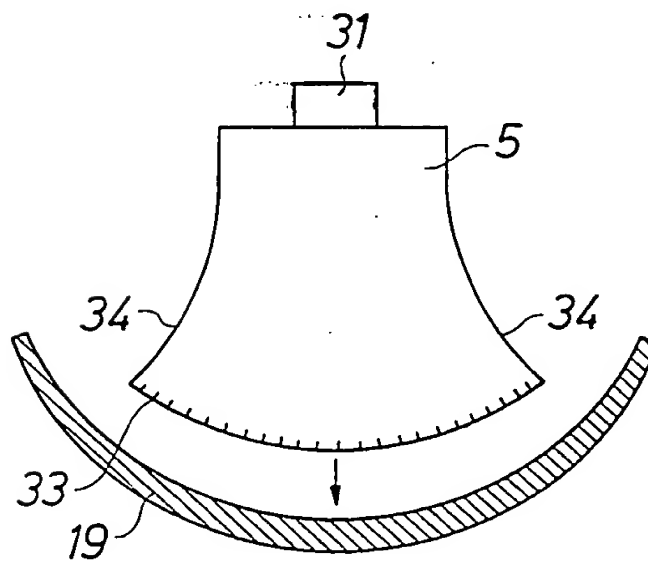
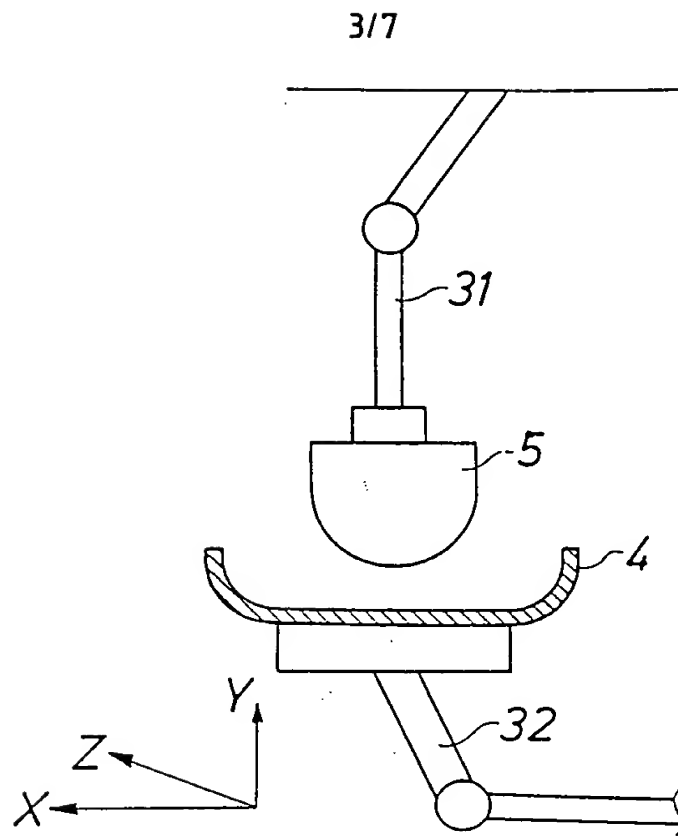


FIG. 3



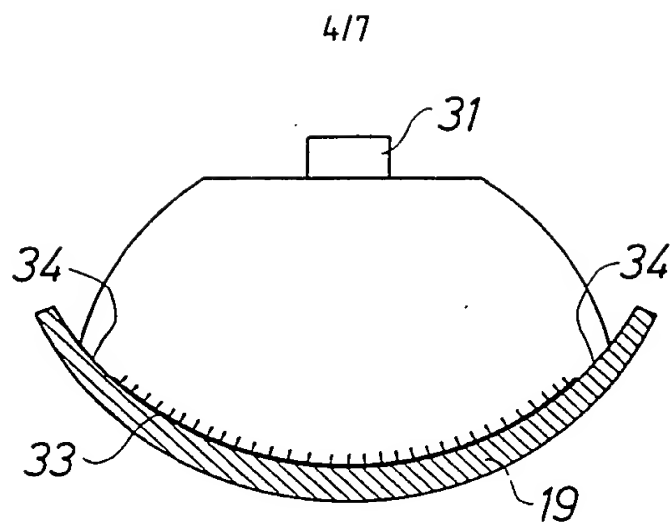


FIG. 6

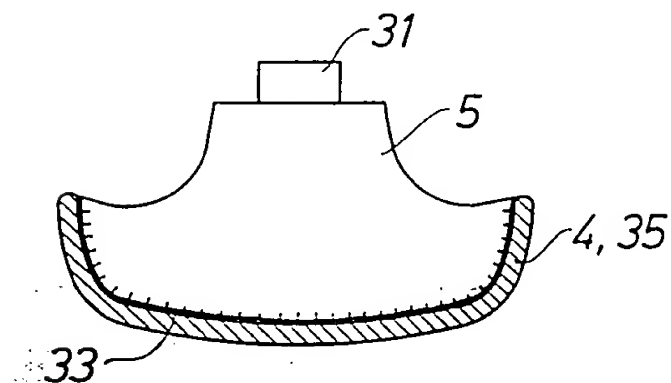


FIG. 7

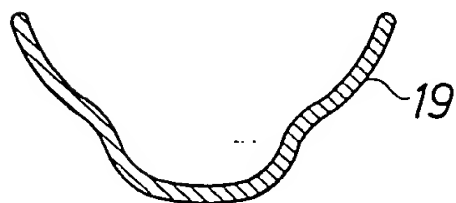


FIG. 8

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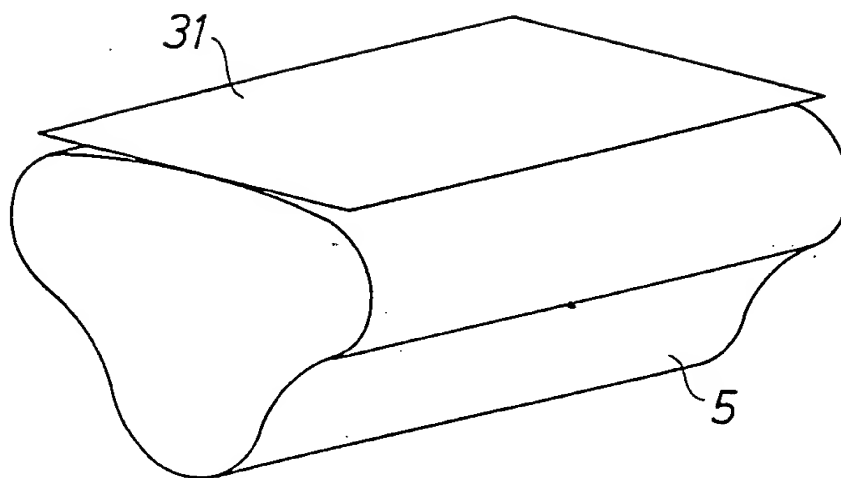


FIG. 9

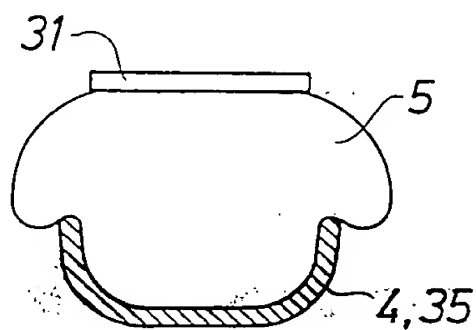


FIG. 10

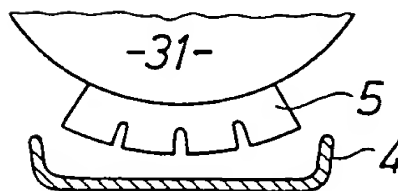


FIG. 11

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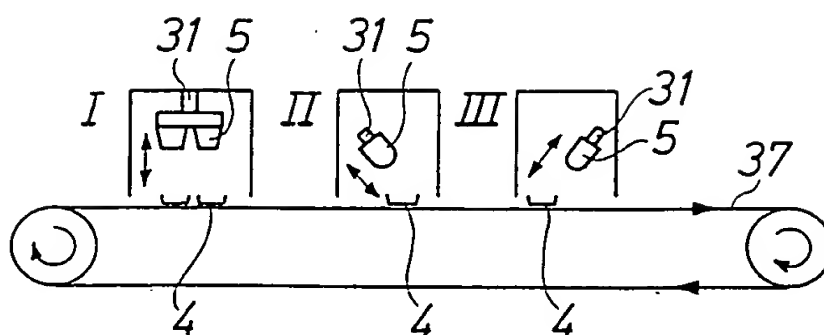


FIG. 12

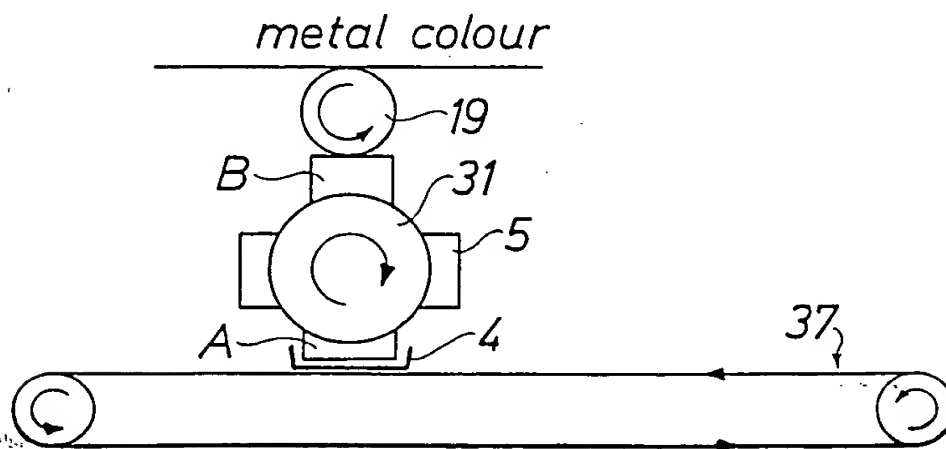


FIG. 13

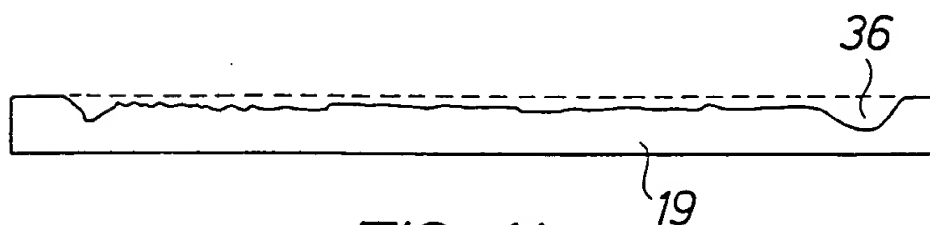


FIG. 14

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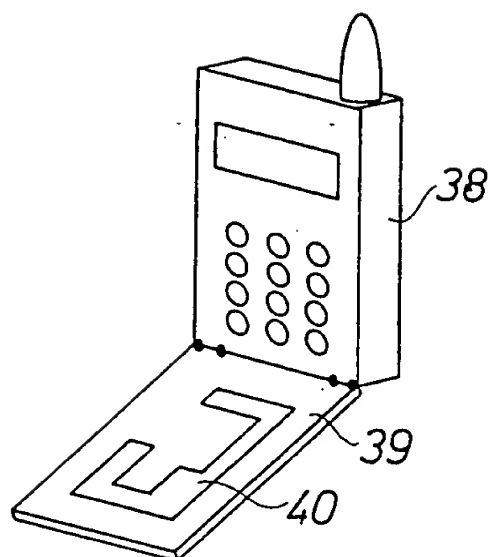


FIG. 15

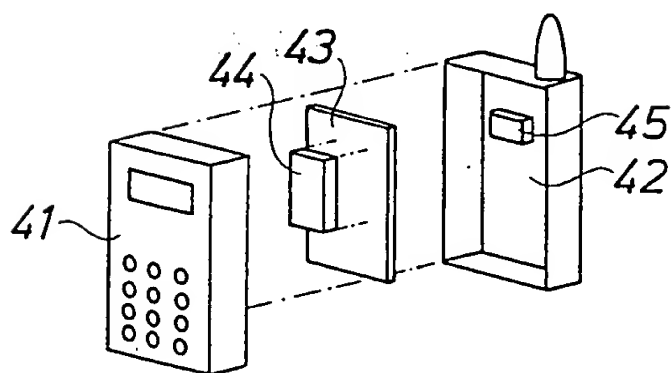


FIG. 16

1
INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01678

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B41F 17/00, B41M 1/40, B41K 3/56, C09D 11/00, H05K 9/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41F, B41K, B41M, C09D, H05K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5383398 A (G. BINNEN), 24 January 1995 (24.01.95), column 1, line 39 - column 7, line 16, figures, abstract	1,2,5,8,11, 13,14,18-26
Y		3,4,6,7,9, 10,12,15-17, 27-30,33
	--	
X	WO 9734459 A2 (TELEFONAKTIEBOLAGET LM ERICSSON), 18 Sept 1997 (18.09.97)	44-47
Y		1-13,15-24, 27-36,42

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

3 February 1999

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Date of mailing of the international search report

14 -02- 1999

Authorized officer

Teija Kurki
Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01678

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E,X	DE 19715379 A1 (TAMPONCOLOR TC-DRUCKMASCHINEN GMBH), 15 October 1998 (15.10.98) --	1,2,5-7,11, 18,20,21
Y	EP 0537649 A1 (MADAG MASCHINEN- UND APPARATEBAU -DIETIKON AG), 21 April 1993 (21.04.93), column 2, line 31 - column 3, line 46, figures, abstract --	1-3,5,8,11, 13,18-24
X	US 4557195 A (W. PHILIPP), 10 December 1985 (10.12.85), column 2, line 1 - line 10; column 3, line 61 - column 4, line 2; column 5, line 3 - line 64, abstract, column 6, line 7 - line 41, column 6, line 64 - column 7, line 4, column 8, line 1 - line 47, column 10, line 24 - column 11, line 2, column 12, line 58 - column 13, line 22, figures --	1-8,11,12, 18-24
Y	 --	31-36,39-43
X	WO 9603466 A1 (COOKSON MATTHEY CERAMICS & MATERIALS LIMITED), 8 February 1996 (08.02.96), page 1, line 15 - page 2, line 26; page 6, line 21 - page 7, line 14; page 8, line 16 - line 23, example 2, example 7 --	37,38
Y	 --	16,17
A	JP 7-214754 A (MINEBEA KK), 15 August 1995 (15.08.95) --	33-35
Y	US 5270493 A (K. INOUE ET AL), 14 December 1993 (14.12.93), column 4, line 2 - line 25; column 5, line 39 - column 6, line 48; column 7, line 46 - line 54, column 8, line 26 - line 36 -- -----	39-43

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01678

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see extra sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

I. Claims 1-32 directed to a method and an arrangement for printing a conductive picture on the surface of a detail by means of a printing means which printing method is known per se.

II. Claims 33-36 directed to a printing pad for printing a conductive picture.

III. Claims 37-38 directed to a metal colour included in a conductive picture.

IV. Claims 39-43 directed to a method for printing an electrical circuit pattern.

V. Claims 44-47 directed to an apparatus having one electrical component to be shielded from electromagnetic radiation.

The "special technical features" of the group I relate to a method and arrangement for printing partial pictures step by step on a surface until the complete picture is achieved. The "special technical features" of the group II relate to a printing pad which is arranged to fetch the colour from a cliché and that it has a shape corresponding to the surface of the detail to be printed. The "special technical features" of the group III relate to a metal colour which includes metal particles, an adhesive and an emulsifying agent in order to obtain a colour with appropriate tixotropy and viscosity for adhering to a printing pad. The "special technical features" of the group IV relate to a method for printing an electrical circuit pattern. The "special technical features" of the group V relate to an apparatus which has at least one electrical component to be shielded from electromagnetic radiation.

These groups of inventions are not so linked as to form a single general inventive concept. There is no technical relationship among those inventions involving one or more of the same or corresponding technical features.

INTERNATIONAL SEARCH REPORT
Information on patent family members

21/12/98

International application No.

PCT/SE 98/01678

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5383398 A	24/01/95	AT 123698 T DE 9114645 U DE 59202538 D EP 0544176 A,B ES 2075994 T DE 9215067 U	15/06/95 21/05/92 00/00/00 02/06/93 16/10/95 11/03/93
WO 9734459 A2	18/09/97	AU 2049297 A AU 6474896 A NO 984135 D SE 9600967 D SE 9604090 D	01/10/97 26/02/97 00/00/00 00/00/00 00/00/00
DE 19715379 A1	15/10/98	NONE	
EP 0537649 A1	21/04/93	NONE	
US 4557195 A	10/12/85	DE 3335230 A,C DE 3472647 A EP 0140165 A,B SE 0140165 T3 JP 1740280 C JP 3006911 B JP 60143963 A	11/04/85 18/08/88 08/05/85 15/03/93 31/01/91 30/07/85
WO 9603466 A1	08/02/96	AU 3084395 A GB 9415075 D	22/02/96 00/00/00
JP 7-214754 A	15/08/95	NONE	
US 5270493 A	14/12/93	CA 2055413 A,C JP 2777747 B JP 4196195 A	27/05/92 23/07/98 15/07/92